

EXECUTIVE SUMMARY

Thank you for your continued hard work sampling **Stone Pond, Marlboro** this year!

We congratulate your group for sampling your pond **once** this summer. However, we strongly encourage your monitoring group to sample **additional** times each summer. Typically, we recommend that monitoring groups sample **three times** per summer (once in **June, July, and August**). We understand that the number of sampling events you decide to conduct per summer will depend upon volunteer availability, and your monitoring group's goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, from year to year, and even from hour to hour during a rain event, it is a good idea to sample the pond at least once per month during the summer.

If you are having difficulty finding volunteers to help sample or to travel to one of the laboratories, please call the VLAP Coordinator and DES will help you work out an arrangement.

We encourage your monitoring group to formally participate in the DES Weed Watchers program, a volunteer program dedicated to monitoring lakes and ponds for the presence of exotic aquatic plants. This program only involves a small amount of time during the summer months. Volunteers survey their waterbody once a month from **May** through **September**. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the waterbody and any islands it may contain. Using the materials provided in the Weed Watcher kit, volunteers look for any species that are suspicious. After a trip or two around the waterbody, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers immediately send a specimen to DES for identification. If the plant specimen is an exotic species, a biologist will visit the site to determine the extent of the problem and to formulate a management plan to control the nuisance infestation. Early detection is the key to controlling the spread of exotic plants.

If you would like to help protect your lake or pond from exotic plant infestations, contact Amy Smagula, Exotic Species Program Coordinator, at 271-2248 or visit the Weed Watchers website at www.des.nh.gov/organization/divisions/water/wmb/exoticspecies/weed_watcher.htm.

OBSERVATIONS & RECOMMENDATIONS

DEEP SPOT

➤ **Chlorophyll-a**

Chlorophyll-a, a pigment found in plants, is an indicator of algal or cyanobacteria abundance. Algae are typically microscopic plants that are naturally found in the lake ecosystem. The measurement of chlorophyll-a in the water gives biologists an estimation of the algal concentration or lake productivity. Table 14 in Appendix A lists the current year chlorophyll-a data.

Figure 1 depicts the historical and current year chlorophyll-a concentration in the water column.

The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m³.

The current year data (the top graph) show that the chlorophyll-a concentration was **2.24 mg/m³** in **July**.

The historical data (the bottom graph) show that the **2008** chlorophyll-a mean is ***much less than*** the state and similar lake medians. For more information on the similar lake median, refer to Appendix D.

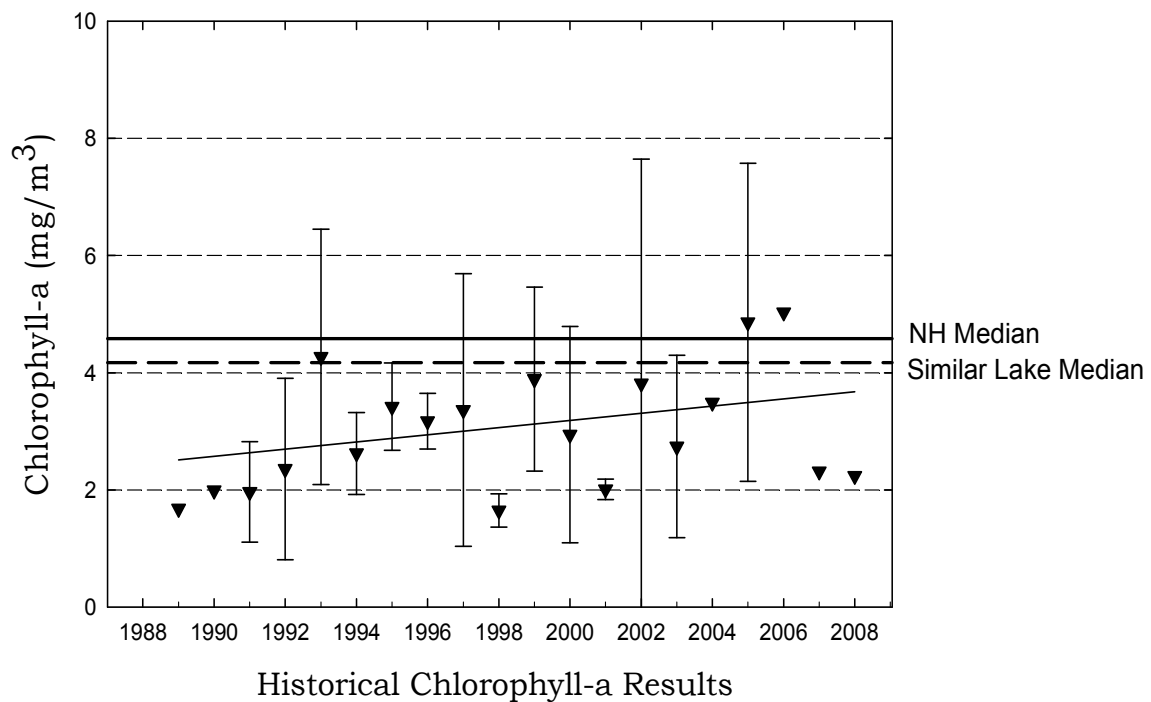
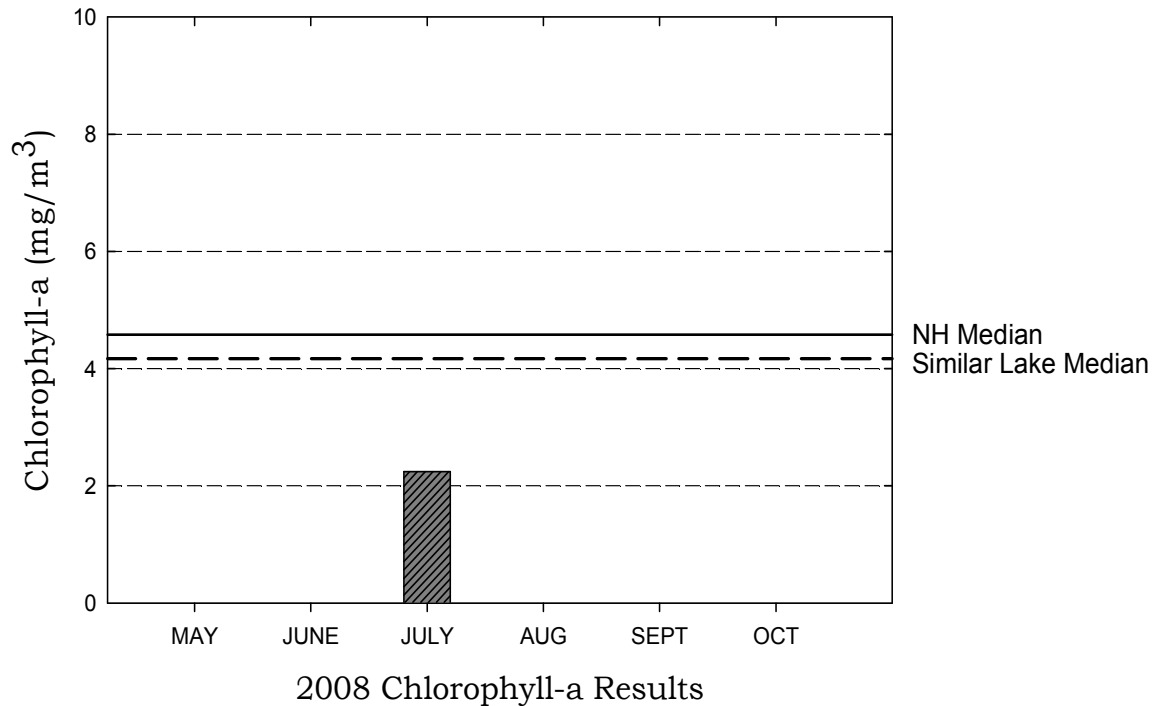
Overall, visual inspection of the historical data trend line (the bottom graph) shows an ***increasing*** in-lake chlorophyll-a trend since monitoring began. Specifically the mean chlorophyll concentration has ***worsened*** since **1989**.

While algae are naturally present in all waterbodies, an excessive or increasing amount of any type is not welcomed. Phosphorus is the nutrient that algae typically depend upon for growth in New Hampshire lakes and ponds. Algal concentrations increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase. Increased Chlorophyll-a concentrations can also affect water clarity, causing Secchi-disk transparency to decrease (worsen) and turbidity to increase (worsen).

Therefore, it is extremely important for volunteer monitors to continually educate all watershed residents about management practices that can be implemented to minimize phosphorus loading to surface waters.

Stone Pond, Marlboro

Figure 1. Monthly and Historical Chlorophyll-a Results



➤ **Phytoplankton and Cyanobacteria**

Table 1 lists the phytoplankton (algae) and/or cyanobacteria observed in the pond in **2008**. Specifically, this table lists the three most dominant phytoplankton and/or cyanobacteria observed and their relative dominance in the sample.

Table 1. Dominant Phytoplankton/Cyanobacteria (July 2008)

Division	Genus	% Dominance
Bacillariophyta	Rhizosolenia	41.6
Chrysophyta	Chrysosphaerella	23.8
Chrysophyta	Dinobryon	11.1

Phytoplankton populations undergo a natural succession during the growing season. Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession. Diatoms and golden-brown algae populations are typical in New Hampshire’s less productive lakes and ponds.

➤ **Secchi Disk Transparency**

Volunteer monitors use the Secchi disk, a 20 cm disk with alternating black and white quadrants, to measure how far a person can see into the water. Transparency, a measure of water clarity, can be affected by the amount of algae and sediment in the water, as well as the natural color of the water. Table 14 in Appendix A lists the current year transparency data. **The median summer transparency for New Hampshire’s lakes and ponds is 3.2 meters.**

Figure 2 depicts the historical and current year transparency ***with and without*** the use of a viewscope.

The current year ***non-viewscope*** in-lake transparency was **5.62 meters in July**.

The current year ***viewscope*** in-lake transparency was **6.17 meters in July**.

The transparency measured with the viewscope was ***greater than*** the transparency measured without the viewscope this summer. As discussed previously, a comparison of the transparency readings taken with and without the use of a viewscope shows that the viewscope typically increases the depth to which the Secchi disk can be seen into the lake, particularly on sunny and windy days. We recommend that your group measure Secchi disk transparency with and without the viewscope on each sampling event.

It is important to note that viewscope transparency data are not compared to a New Hampshire median or similar lake median. This is because lake transparency with the use of a viewscope has not been historically measured by DES. In the future, the New Hampshire and similar lake medians for viewscope transparency will be calculated and added to the appropriate graphs.

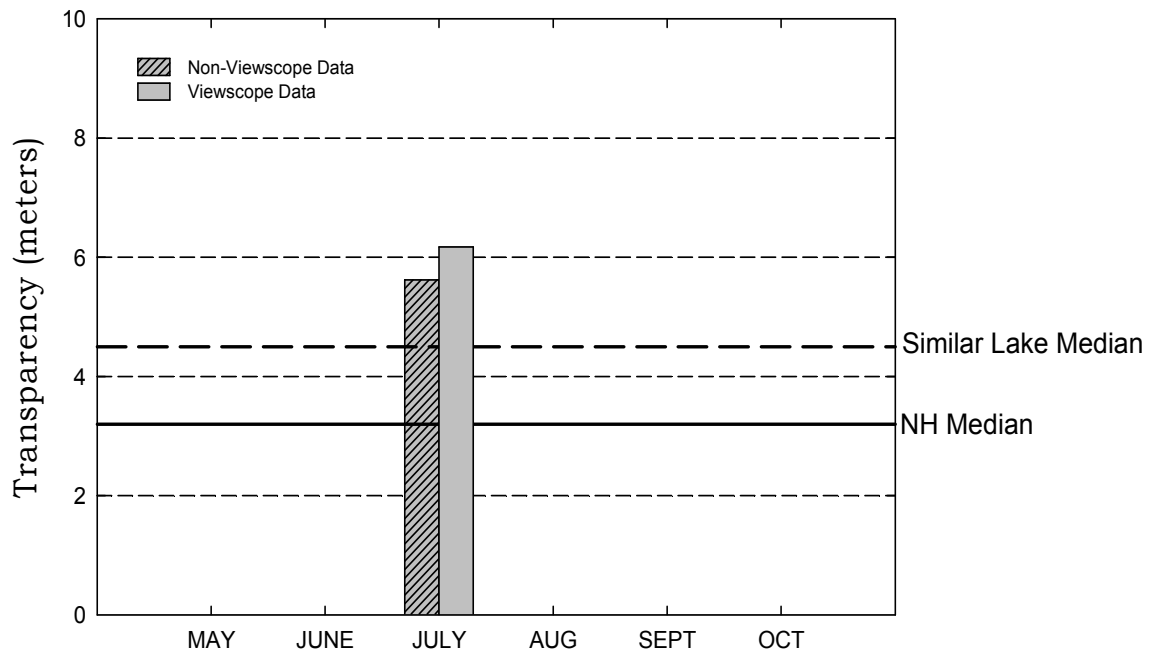
The historical data (the bottom graph) show that the **2008** mean non-viewscope transparency is ***much greater than*** the state median and is ***slightly greater than*** the similar lake median. Please refer to Appendix D for more information about the similar lake median.

Visual inspection of the historical data trend line (the bottom graph) shows a ***stable*** trend. Specifically, the transparency has ***remained relatively stable ranging between 4.00 and 6.23 meters*** since monitoring began in **1989**.

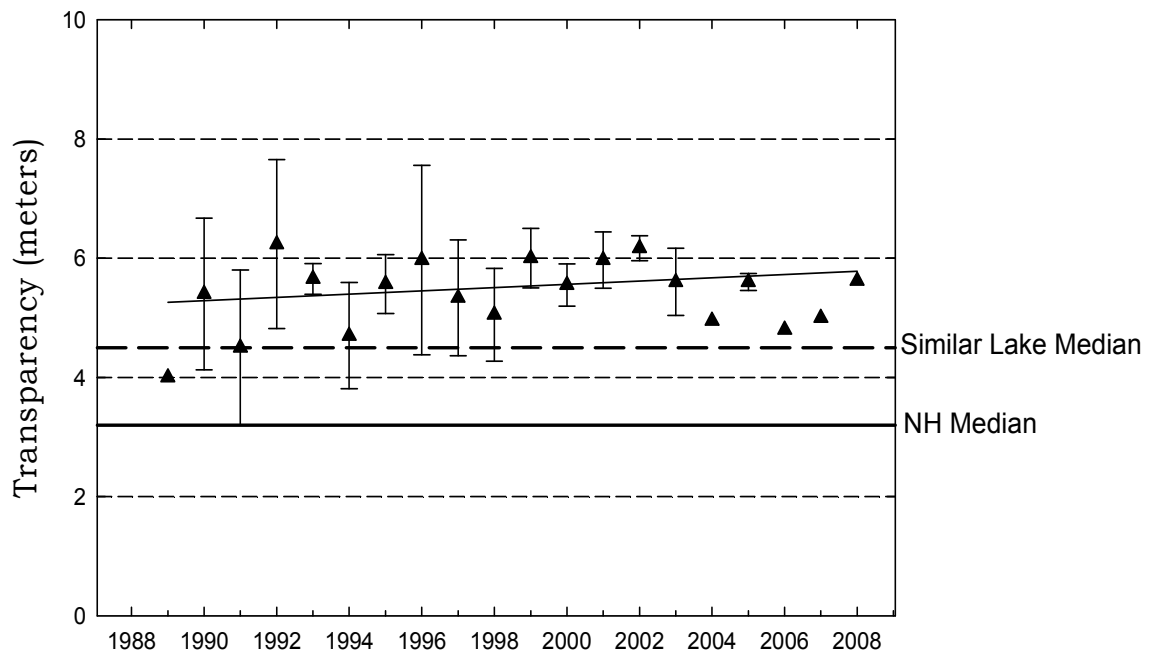
Typically, high intensity rainfall causes sediment-laden stormwater runoff to flow into surface waters, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the pond. Guides to best management practices that can be implemented to reduce, and possibly even eliminate, nonpoint source pollutants, are available from DES upon request.

Stone Pond, Marlboro

Figure 2. Monthly and Historical Transparency Results



2008 Transparency Viewscape and Non-Viewscope Results



Historical Transparency Non-Viewscope Results

➤ **Total Phosphorus**

Phosphorus is typically the limiting nutrient for vascular plant and algae growth in New Hampshire's lakes and ponds. Excessive phosphorus in a pond can lead to increased plant and algal growth over time. Table 14 in Appendix A lists the current year total phosphorus data for in-lake and tributary stations. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The graphs in Figure 3 depict the historical amount of epilimnetic (upper layer) and hypolimnetic (lower layer) total phosphorus concentrations; the inset graphs depict current year total phosphorus data.

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***non-detectable*** in **July**.

The historical data show that the **2008** mean epilimnetic phosphorus concentration is ***much less than*** the state and similar lake medians. Refer to Appendix D for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration was **12 ug/L** in **July**.

The historical data show that the **2008** mean hypolimnetic phosphorus concentration is ***slightly less than*** the state and similar lake medians. Please refer to Appendix D for more information about the similar lake median.

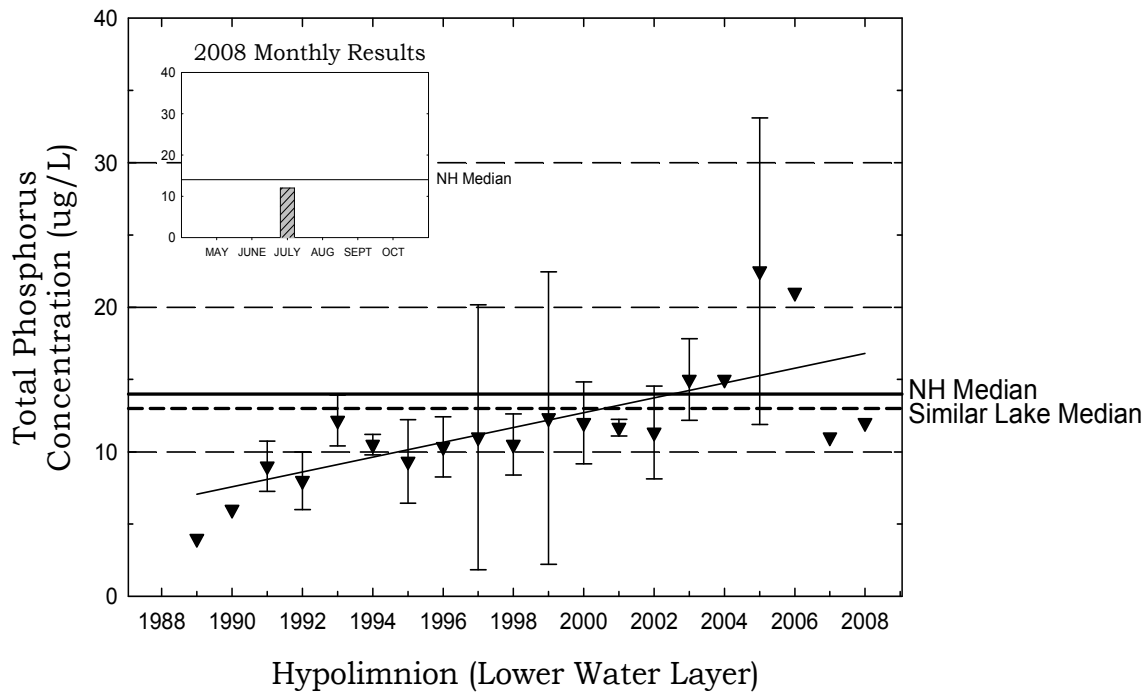
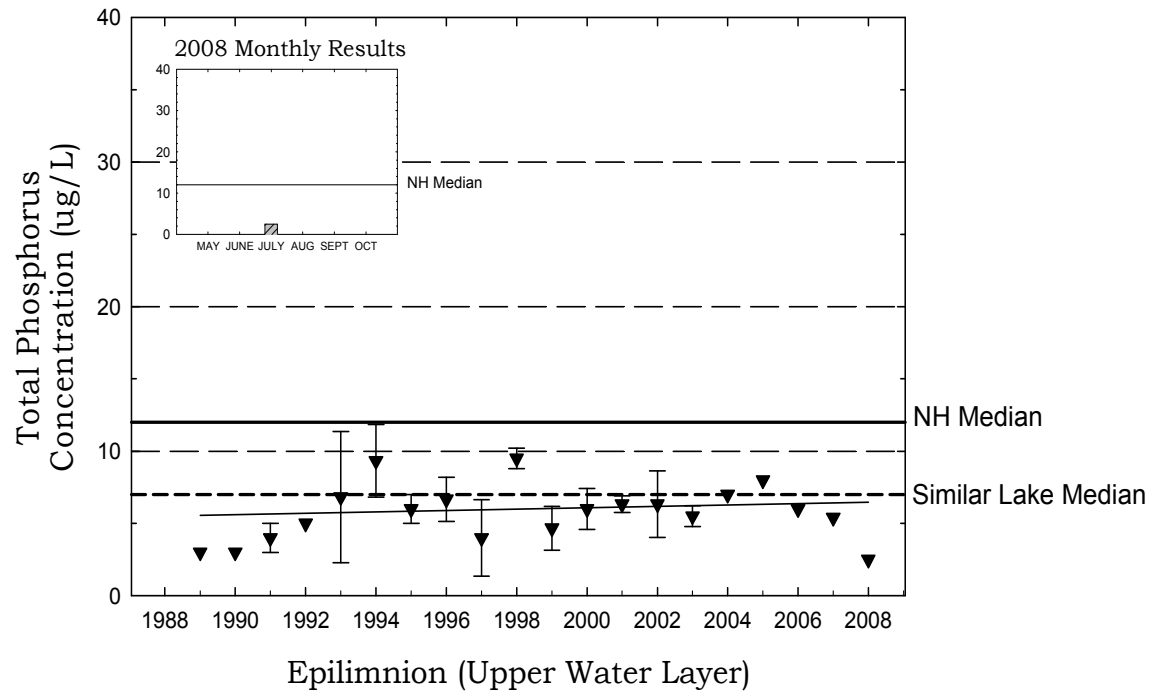
Overall, visual inspection of the historical data trend line for the epilimnion shows a ***relatively stable*** phosphorus trend. Specifically, the mean annual epilimnetic phosphorus concentration has ***remained approximately the same*** since monitoring began in **1989**.

Overall, visual inspection of the historical data trend line for the hypolimnion shows an ***increasing*** phosphorus trend since monitoring began. Specifically the mean annual concentration has ***worsened*** since monitoring began in **1989**.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about the watershed sources of phosphorus and how excessive phosphorus loading can negatively affect the ecology and the recreational, economical, and ecological value of lakes and ponds.

Stone Pond, Marlboro

Figure 3. Monthly and Historical Total Phosphorus Data



➤ pH

Table 14 in Appendix A presents the current year pH data for the in-lake stations.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 typically limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the state surface waters are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The pH at the deep spot this year ranged from **6.43** in the epilimnion to **5.11** in the hypolimnion, which means that the water is ***slightly acidic***.

It is important to point out that the hypolimnetic (lower layer) pH was ***lower (more acidic)*** than in the epilimnion (upper layer). This increase in acidity near the bottom is likely due to the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the state's abundance of granite bedrock and acid deposition received from snowmelt, rainfall, and atmospheric particulates, there is little that can be feasibly done to effectively increase pond pH. The pH at the deep spot, however, is sufficient to support aquatic life.

➤ Acid Neutralizing Capacity (ANC)

Table 14 in Appendix A presents the current year epilimnetic ANC for the deep spot.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation about ANC, please refer to the "Chemical Monitoring Parameters" section of this report.

The acid neutralizing capacity (ANC) of the epilimnion (upper layer) was **1.8 mg/L**. This indicates that the pond is ***extremely vulnerable*** to acidic inputs.

➤ Conductivity

Table 14 in Appendix A presents the current conductivity data for in-lake stations.

Conductivity is the numerical expression of the ability of water to carry an electric current, which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column. The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The conductivity in the pond is relatively **stable** and **low**. Typically conductivity levels greater than 100 uMhos/cm indicate the influence of pollutant sources associated with human activities. These sources include septic system leachate, agricultural runoff, and road runoff which contains road salt during the spring snow-melt. We hope this trend continues!

➤ **Dissolved Oxygen and Temperature**

Table 9 in Appendix A depicts the dissolved oxygen/temperature profile(s) collected during **2008**.

The presence of sufficient amounts of dissolved oxygen in the water column is vital to fish and amphibians and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was greater than **100 percent** saturation between **5.0** and **8.0** meters at the deep spot on the **July** sampling event. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column. Layers of algae can also increase the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. Considering that the depth to which sunlight could penetrate into the water column was approximately **6.0** meters on this sampling event, as shown by the Secchi disk transparency depth, and that the metalimnion, the layer of rapid decrease in water temperature and increase in water density where algae typically congregate, was located between approximately **5.0** and **8.0** meters, we suspect that an abundance of algae in the metalimnion caused the oxygen super-saturation.

The dissolved oxygen concentration was **lower in the hypolimnion (lower layer) than in the epilimnion (upper layer)** at the deep spot on the **July** sampling event. As stratified ponds age, and as the summer progresses, oxygen typically becomes **depleted** in the hypolimnion by the process of decomposition. Specifically, the reduction of hypolimnetic oxygen is primarily a result of biological organisms using oxygen to break down organic matter, both in the water column and particularly at the bottom of the pond where the water meets the sediment. When the hypolimnetic oxygen concentration is depleted to less than 1 mg/L, the phosphorus that is normally bound up in the sediment may be re-released into the water column, a process referred to as **internal phosphorus loading**.

The **lower** hypolimnetic oxygen level is a sign of the pond's **aging** health. This

year the DES biologist collected the dissolved oxygen profile in **July**. We recommend that the annual biologist visit for the **2009** sampling year be scheduled during **June** so that we can determine if oxygen is depleted in the hypolimnion **earlier** in the sampling year.

➤ **Turbidity**

Table 14 in Appendix A presents the current year data for in-lake turbidity.

Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The deep spot turbidity was **relatively low** this year, which is good news.

However, we recommend that your group sample the pond and any surface water runoff areas during significant rain events to determine if stormwater runoff contributes turbidity and phosphorus to the pond.

For a detailed explanation on how to conduct rain event sampling, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at

<http://www.des.nh.gov/organization/divisions/water/wmb/vlap/categories/publications.htm>, or contact the VLAP Coordinator.

TRIBUTARY SAMPLING

➤ **Total Phosphorus**

Table 14 in Appendix A presents the current year total phosphorus data for tributary stations. Please refer to the “Chemical Monitoring Parameters” section of the report for a detailed explanation of total phosphorus.

Tributary sampling was not conducted in 2008. We recommend sampling the tributaries in 2009.

➤ **pH**

Table 14 in Appendix A presents the current year pH data for the tributary stations. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation of pH.

Tributary sampling was not conducted in 2008. We recommend sampling the tributaries in 2009.

➤ **Conductivity**

Table 14 in Appendix A presents the current conductivity data for the tributary stations. Please refer to the “Chemical Monitoring Parameters” section of the report for a more detailed explanation of conductivity.

Tributary sampling was not conducted in 2008. We recommend sampling the tributaries in 2009.

➤ **Turbidity**

Table 14 in Appendix A presents the current year turbidity data for the tributary stations. Please refer to the “Other Monitoring Parameters” section of the report for a more detailed explanation of turbidity.

Tributary sampling was not conducted in 2008. We recommend sampling the tributaries in 2009.

➤ **Bacteria (*E. coli*)**

Table 14 in Appendix A lists the current year data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that

sewage **may** be present. If sewage is present in the water, potentially harmful disease-causing organisms **may** also be present. Please refer to the “Other Monitoring Parameters” section of the report for a more detailed explanation.

Bacteria sampling was not conducted this year. If residents are concerned about sources of bacteria such as failing septic systems, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high, when beach use is heavy, or immediately after rain events.

➤ **Chlorides**

Table 14 in Appendix A lists the current year data for chloride sampling. The chloride ion (Cl-) is found naturally in some surface waters and groundwaters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted **acute and chronic** chloride criteria of **860 and 230 mg/L** respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Chloride sampling was **not** conducted during **2008**.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your pond, the biologist trained your group how to collect samples at the deep spot and the outlet. Your group learned very quickly and did a great job following instructions.

In future years, the biologist will conduct a “Sampling Procedures Assessment Audit” of your monitoring group during the annual visit. Specifically, the biologist will observe the performance of your monitoring group while sampling and will document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors fail to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, DES fact sheet ARD-32, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-32.pdf.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, DES Booklet WD-03-42, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-03-42.pdf.

Impacts of Development Upon Stormwater Runoff, DES fact sheet WD-WQE-7, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/aot/documents/wqe-7.pdf.

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, DES fact sheet WD-BB-9, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-9.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, DES fact sheet WD-SP-2, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-2.pdf.

Road Salt and Water Quality, DES fact sheet WD-WMB-4, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-4.pdf.

Sand Dumping - Beach Construction, DES fact sheet WD-BB-15, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-15.pdf.

Shorelands Under the Jurisdiction of the Comprehensive Shoreland Protection Act, DES fact sheet SP-4, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-4.pdf.

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, DES fact sheet WD-BB-4, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-4.pdf.